Utilization of Clamshell as Filler and Addition of Sikafume on The Examination of High Quality Concrete

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Abstract. Various research and experiments in the field of concrete is done as an effort to improve the quality of concrete, materials technology and implementation techniques obtained from the results of research and experiment, it is intended to answer the higher demands on the use of concrete and overcome the constraints that often occur in the implementation of the concrete work in the site. The purpose of this research was to compare the value of compressive strength of normal concrete with compressive strength of concrete using SikaFume and clamshell. The compositions of the SikaFume mixture used in this research were 5% and 8% and for the shellfish used were also 5% and 8% of the weight of cement for all variations. The test specimens used were cylindrical, the planned concrete quality was 45 MPa tested at 21 days and 28 days with prior curing before testing. This research tested concrete with cylindrical test object for compression test of 30 specimens and consisted of 2 variations and each variation of 5 samples. From this research, it was found that the highest concrete compressive strength was found in the 8% SikaFume addition concrete mix and 8% shellfish at 28 days old that is 45.62 MPa when compared with the normal concrete.

Keywords:High Quality Concrete, SikaFume, Clamshells, Strong Concrete Press

1 Introduction

Concrete as a material that dominates the building should be planned well in order to avoid any possibilities of the worst that may happen. With the development of science and technology, much research has been done to improve the properties of the concrete especially in terms of its strength to withstand load, durability, durability and ease of processing. To know the strength of concrete, generally used compression test.

According to Murdock and Brook (1979), the compressive strength of the concrete is influenced by a number of factors, other than by the ratio of cement water and the degree of compaction. Other important factors are:

1. Type of cement and its quality.
2. Types and aggregates of aggregate surface areas.
3. Efficiency of curing on the concrete.
4. Temperature.
5. Age.

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This research was conducted to get a new alternative in concrete technology by utilizing waste which has no selling value that is clamshell as a filler of concrete mixture, so that the concrete mixture will have more economical value.

Considering from the impact of the waste, in this research will be tried using clamshell as filler, where the clamshell is a material obtained from the remnant of food that has been consumed by humans, before becoming a waste clamshell are widely used for handicrafts molded in such a way for indoor decoration. In sufficient quantities it is necessary to do further research on the use of clamshell in an effort to increase the compressive strength of concrete, in this case high quality concrete, resulting in a concrete mixture of strong and cheap, and environmentally friendly. The chemical composition of clamshell can be seen from Table 1.

Table 1. The chemical composition contained in the clamshell.

Chemical Content	Composition (%) Weight
Silica (SiO2)	7,88
Alumina (Al2O3)	1,25
Iron Oxide (Fe2O3)	0,03
Lime (CaO)	66,70
Magnesia (MgO)	22,28

Fig.1. Clamshells Waste

Fig. 2. Clamshells after smoothing process

SikaFume is the latest generation additive of silica fume technology in the form of flour, SikaFume can be used very effectively to produce high quality concrete. There are more than 95% SiO2 particles that less than one micron (Sika Indonesia, 2003). SikaFume is useful for improving the impermeability, durability or compressive resistance for concrete, Sika Fume can prove the characteristic that influencing the concrete as following:

a. Increased working time and longer period of time.
b. Increased stability of concrete.
c. Increased enormous durability.
d. Increased water permeability in concrete mixtures.
e. Increased initial stress and strength of concrete (Sika Indonesia, 2003).
f. Boosts resistance to carbonation.
g. Chloride infiltration is greatly reduced.
h. Very high initial strength and end power.

The compressive strength for each age of concrete and average strength depends on the percentage characteristics of SikaFume, the use of cement, and the use of other concrete-forming materials. Concrete using additional form of SikaFume will experience the development of concrete strength.

The compressive strength of concrete with SikaFume additives is excellent and is a fairly economical alternative to use. SikaFume materials have several advantages that are:

Table 2. Chemical and Physical Composition of SikaFume

Chemical	**Weight (%)**
SiO_2	92 - 94
Carbon	3 - 5
Fe_2O_3	0.10 - 0.150
CaO	0.10 - 0.150
Al_2O_3	0.20 - 0.30
MgO	0.10 - 0.20
MnO	0.008
K_2O	0.10
Na_2O	0.10
Phisycal	**Weight**
Specific gravity	2.02
Average particle size (μm)	0.1
Escaped No. 325 sieve in %	99.00
Acidity of pH	7.3

(Source: Yogendran., et al,. ACI Material Journal, Maret-April, 1987)

1.1 Formulation of Problems

Various problems such as testing type of concrete are quite large, namely compressive strength test, tensile strength test, bending test and others, as well as concrete or hardening grades such as 21 or 28 days need to be done as a comparison to fit the expected. For clamshell waste and SikaFume with the permitted percentage of maximum 15%. Standardization of methods in the planning and work of concrete mixture is quite a lot, including ASTM method, SNI method, ACI method and others.

1.2 Research Aims

Compare the value of compressive strength of normal concrete (pure concrete without additive/mixture) with concrete compressive strength using SikaFume and seashell and to know the effect of SikaFume and clamshell with percentage of 5% and 8%.

2 Research Methodology

2.1 Aggregate Examination

The aggregate used in this research is from Binjai and the cement used is PPC type I, the aggregate examinations that carried out are: Aggregate sieving analysis, Specific gravity and absorption, Aggregate weight checking, Aggregate water grade examination, Aggregate sludge examination and Inspection aggregate with a Los Angeles engine based on ASTM standards.

2.2 Slump Test and Curing

To know the crunch of a concrete mix is usually done slump testing. Curing is done with Standard Curing that is using water media. The concrete is immersed in water for as long as necessary. The sample used in this research is cylinder with 150 mm diameter size and 300 mm height as many as 30 pieces.

2.3 Compressive Strength

A compressive strength test is performed to determine the compressive strength from the specimen. Compressive strength measurements based on SNI 03-1974-1990 can be calculated with the following function.

$$f(\text{during testing}) = \frac{P}{A}$$

Where:
f(during testing) = Compressive strength during testing (kg/cm^2).
P = Pressure Load (kg).
A = Surface area (cm^2).

3 Result and Discussion

3.1 Results of the Aggregate Examination

From the examination results found the following data:
a. Specific gravity of coarse aggregate = 2.69 gr/cm^3
b. Specific gravity of fine aggregate = 2.77 gr/cm^3
c. Coarse aggregate sludge content = 0.18%
d. Fine aggregate sludge content = 0.38%
e. The coarse aggregate density = 1.45 gr/cm^3

f. The fine aggregate density = 1.26 gr/cm^3
g. FM of coarse aggregate = 6.48
h. FM of fine aggregate = 2.49
i. Coarse aggregate water content = 1.05%
j. Fine aggregate water content = 5.49%
k. Absorption of coarse aggregate = 4.3%
l. Fine aggregate absorption = 2.68%
m. Rough aggregate wear = 43%
n. Planned slump value = 30-60 mm
o. Maximum aggregate size = 38.1 mm

3.2 Mix Design Results

Mix Design was analyzed and made in Table 3.

Table 3. Planning of concrete mix of SNI 03-2834-1993.

No.	Description	Table/Picture Calculation	Value
1	Required compressive strength (cylindrical test object)	Determined	45 MPa
2	Standard Deviation	Table 2.6	12 MPa
3	Value added (margin)	Table 2.7	5.6 MPa
4	Targeted average power	1+2+3	62.6 MPa
5	Type of cement	Determined	Type I
6	Type of aggregate: - Coarse	Determined	Binjai Split Stone
	- Fine	Determined	Binjai Natural Sand
7	Free cement water factor	Figure 4.1	0.48
8	Maximum cement water factor	Determined	0.60
9	Slump	Determined	30-60 mm
10	Maximum aggregate size	Determined	38.1 mm
11	Free moisture	Figure 4.7	171.9 kg/m^3
12	Cement quantity	11:7	358.125 kg/m^3
13	Maximum cement quantity	Determined	358.125 kg/m^3
14	Minimum cement quantity	Determined	275 kg/m^3
15	Adjusted water cement factor	-	0.6
16	Large arrangement of fine aggregate grains	Figure 3.2	Zone 2 Gradation area
17	Arrangement of coarse aggregate of combinations	Figure 3.3	40 mm maximum gradient
18	Percentage of fine aggregate	Figure 4.2	35%
19	Relative weight, aggregate (dry surface)	Determined	2.655
20	Concrete density	Figure 4.3	2425 kg/m^3
21	Combined aggregate content	20-12-11	1894.975 kg/m^3
22	Fine aggregate content	18 x 21	663.241 kg/m^3
23	Coarse aggregate content	21-22	1231.734 kg/m^3
24	Proportion of mixture	Semen (kg) Air (kg)	The aggregate of saturated dry surface conditions (kg) Fine Coarse

No.	Description	Table/Picture Calculation		Value	
	- Each m^3	358.125	171.9	663.241	123 1.734
	- Each of m3 test mixture	1	0.480	1.852	3.439
	Each of 0.0034 m^3 mixture (1 cubic)	1.209	0.580	2.238	4.157
25	Correction of mixture proportions				
	- Each m^3	358.125	171.1	663. 238	123 2.54
	- Each of m3 test mixture	1	0.478	1.852	3.442
	- Each of 0.0034 m^3 mixture (1 cubic)	1.209	0.577	2.238	4.160

3.3 Compressive Strength Result

The compressive strength results obtained by comparison of mix design for normal concrete and concrete with shellfish + SikaFume with 5% and 8% percentages at 21 days and 28 days that listed in table 4.

Table 4. Compressive Strength Test Results.

No.	Concrete Type	21 Days Old [MPa]	28 Days Old [MPa]
1.	Normal Concrete	33,55	37,63
2.	5% Clamshell + 5% *SikaFume* Concrete	38,07	42,45
3.	8% Clamshell + 8% *SikaFume* Concrete	40,09	45,62

From the results above can be seen the value of concrete compressive strength is greater than the planned compressive strength of the concrete that is 45 MPa at the age of 28 days.

Compared to normal concrete compressive strength with concrete using clamshell + SikaFume, it can be seen on concrete that using 5% clamshell + SikaFume is increasing and concrete using shell + SikaFume as much as 8% is also increasing.

The percentage of improvement can be seen in the calculations below:

a. 5% Aggregate Replacement (Filler) and 5% additive additions

$$\text{Magnitude of the increasing value (21 days old)} = \frac{38,07 - 33,55}{33,55} \times 100\%$$
$$= 13,47\ \%$$

b. 8% Aggregate Replacement (Filler) and 8% additive additions

$$\text{Magnitude of the increasing value (21 days old)} = \frac{40,09 - 33,55}{33,55} \times 100\%$$
$$= 19,49\ \%$$

c. 5% Aggregate Replacement (Filler) and 5% additive additions

$$\text{Magnitude of the increasing value (28 days old)} = \frac{42{,}45 - 37{,}63}{37{,}63} \times 100\%$$
$$= 12{,}81\ \%$$

d. 8% Aggregate Replacement (Filler) and 8% additive additions

$$\text{Magnitude of the increasing value (28 days old)} = \frac{45{,}62 - 37{,}63}{37{,}63} \times 100\%$$
$$= 21{,}12\ \%$$

Percentage increase of concrete compressive strength in concrete with clamshell + SikaFume occurred at 21 days and 28 days, this significant increase of compressive strength caused by several factors. The factors that can cause this to occur include the use of shells containing silica and lime on the concrete mixture that can increase the maximum compressive strength.

4 Conclusions

The results of testing and research that has been done can be drawn some conclusions, that is:

a. The addition of SikaFume and clamshell to concrete has an effect on compressive strength, where the compressive strength of concrete with the addition of SikaFume + clamshell with 5% each at 21 days is 38.07 MPa or an increase of 13.47% when compared with normal concrete that is equal to 33,55 MPa, compressive strength of concrete addition of SikaFume + clamshell with 8% each at 21 days old is 40,09 MPa or increase of equal to 19,49% when compared with normal concrete that is equal to 33,55 MPa.
b. Compressive strength of concrete with the addition of SikaFume + clamshell with 8% each at 28 days old is 42,45 MPa or increased by 12,81% when compared with normal concrete that is equal to 37,63 MPa, compressive strength of concrete with the addition of SikaFume + clamshell with 8% each at 28 days old is 45,62 MPa or increased by 21,12% when compared with normal concrete that is equal to 37,63 MPa.
c. From the results of compressive strength obtained in the compression test can not be determined the increase in compressive strength influenced by the SikaFume itself or by the addition of clamllfish as filler, this is due to the variations made is less variative, it can be seen the variations used, in the first experiment the addition of 5% filler and 5% SikaFume and then the second variation was done by adding 8% filler and 8% SikaFume. What should be done in the second experiment is not a percentage increase in the SikaFume (fixed at 5% condition) to see the SikaFume or the filler that affecting the increase in compressive strength of the concrete.

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